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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of

Amendment of Part 15 of the Commission's
Rules Regarding Spread Spectrum Devices

Wi-LAN, Inc., Application for Certification
of an Intentional Radiator Under Part 15
of the Commission's Rules

ET Docket No. 99-231

DA 00-2317

COMMENTS OF SILICON WAVE, INC.

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Comments of Silicon Wave, Inc.

I. Introduction

Silicon Wave, Inc. ("Silicon Wave"), a leading designer and producer of RF systems on-chip for use in wireless and broadband systems, appreciates this opportunity to comment on the Commission's proposed changes to its rules governing unlicensed spread spectrum devices. The release of this rulemaking evidences the Commission's continuing commitment to facilitate technological innovation and eliminate regulatory barriers. Indeed, the Commission's past action upon this commitment is largely responsible for the tremendous role that unlicensed devices play in the lives of individual consumers and American business today.

Silicon Wave fully endorses the intent of this further notice of proposed rulemaking ("FNPRM"). Its comments serve to explain the benefits of several of the Commission's proposals, as well as to note two areas where significant additional thought by Commission is warranted prior to action. First, Silicon Wave strongly supports the expansion of the scope of the Commission's adaptive hopping rules by

permitting both narrowband and wideband hopping systems to use reduced frequency hop sets. Silicon Wave also supports an expansion of the rules to accommodate new digital technologies (“DTS”), such as Orthogonal Frequency Division Multiplexing (“OFDM”). It urges the Commission, however, to define the scope of these digital technologies within the context of direct sequence spread spectrum (“DSSS”) and frequency hopping spread spectrum (“FHSS”) systems, so as to avoid regulatory gamesmanship whereby a new device could be “shopped” among the regulatory categories to obtain advantageous regulatory treatment. Finally, Silicon Wave supports expansion of the upper portion of the U-NII band to 5.850 GHz, effectively aligning 5 GHz spread spectrum band and the upper portion of the U-NII band. Any consolidation of the Section 15.247 and U-NII rules, however, should involve careful consideration of gaps and inconsistencies between the sets of rules that could inadvertently create substantive changes for the 2.4 GHz band, adversely affecting incumbent and planned usage.

II. Silicon Wave Profile

Based in San Diego’s Telecom Valley, Silicon Wave produces entire RF systems on chip for original equipment manufacturers serving the wireless and cable communications markets. Silicon Wave is a member of the HomeRF Working Group; the IEEE 802.11 Committee, including the 802.11(h) and the Joint 802.11/802.15 Regulatory Working Groups; and an Associate member of the Bluetooth Special Interest Group, serving on its technical review board and committees on radio, testing, software and regulatory affairs.

Silicon Wave created the first single-chip Bluetooth radio-modem. Because the entire RF system, including both radio and digital applications, is fully integrated on a single chip, Silicon Wave's products offer the tremendous advantages of minimal power consumption and size with substantially increased cost efficiency. These advantages allow equipment manufacturers to provide consumers with high-performance advanced products where power and space are crucial, such as wireless handsets, laptops, set-top boxes and cable modems.

One of the company's products, the SiW 1502 Radio Modem IC, is a 2.4 GHz radio transceiver with a GFSK modem. This low cost, low power solution integrates RF logic and Bluetooth protocol stack for a wide variety of Bluetooth applications, including links among computers, mobile phones, handheld devices, and connectivity to the Internet.

III. Adaptive Hopping

Silicon Wave strongly supports the adaptive hopping proposals made in the FNPRM. Specifically, the Commission has proposed to allow FHSS systems in the 2.4 GHz band to use a reduced hop set of "as few as 15 hops, as provided by our current rules, irrespective of the bandwidth utilized, provided that the output power does not exceed 125 mW and the device uses adaptive hopping techniques."¹ At present, Section 15.247(h) expressly authorizes adaptive hopping as a means to minimize interference. Nonetheless, because Section 15.247(a)(1)(ii) requires narrowband hoppers (those up to 1 MHz) to use at least 75 hopping frequencies, and

¹ In the Matter of Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices, *Further Notice of Proposed Rulemaking and Order*, 16 FCC Rcd 10036 (2001), at ¶13.

the band itself is only 83.5 MHz, this ninety percent occupancy requirement effectively precludes the use of adaptive hopping.

Notably, in the *First Report and Order* in this docket, the Commission recently authorized wideband hoppers (those ranging from 1-5 MHz).² While doing so, the Commission assured the opportunity for wideband adaptive hopping by permitting those systems to use as few as 15 hopping frequencies, yet it continued to require that the total span of the channels be at least 75 MHz.

Silicon Wave believes that the Commission must resolve the conflict between Sections 15.247(h) and 15.247(a)(1)(ii) by similarly modifying the rules so that narrowband hoppers may use the reduced hop set now permitted to wideband hoppers. The Commission has long recognized the value of adaptive hopping. Adaptive hopping benefits *both* systems potentially involved in any interference. Because the adaptive hopper can intelligently sense the occupancy of a frequency by another user, it can preemptively move to a different frequency, rather than moving only *after* interfering by attempting to use the frequency. Naturally this protects the system using the frequency in question from unnecessary interference and eliminates the inefficiencies of error correction. In addition, it is a far more efficient process for the adaptive hopping system because it avoids unnecessary and redundant transmissions.

The operating parameters that the Commission proposes as preconditions for use of a reduced hop set – a reduction in power from 1 W to 125 mW and the use of

² In the Matter of Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices, *First Report and Order*, 15 FCC Rcd 16244 (2000) ("First Report and Order").

adaptive hopping – are entirely appropriate.³ That these parameters have worked to minimize successfully interference from wideband hoppers reinforces that they should work equally well for narrowband hoppers. Use of a minimum set of 15 hopping frequencies is also consistent with the Commission’s decision in the *First Report and Order*. A 15 frequency hop set equates to use of more than 20 percent of the effective bandwidth available. This assures significant spreading and will prevent over-occupancy of any portion of the spectrum by any one system. Yet it also allows for much more intensive use of the band without any increase in interference. Importantly, by facilitating the coexistence of multiple FHSS users, with the least interference to DSSS users, this modification will open the gates to important innovations that are already on the horizon. These include multiple new users in the band, such as Bluetooth and Wireless LANs (IEEE 802.11b standard). This change will also promote innovation due to the possibility of integrating FHSS and DHSS systems into the same system or device, enabling consumers to use a variety of wireless technologies to optimize access to private, local networks and to the Internet. Silicon Wave is actively engaged in development and production that will further all of these uses.

IV. Digital Transmission Technologies

The Commission’s proposal to allow new digital transmission technologies under Part 15.247 is another positive step in allowing valuable innovations to come to

³ As a general proposition, the decision to use adaptive hopping should be left to manufacturers. However, Silicon Wave agrees that it is appropriate, as a precondition to use of a reduced hop set, to require use of adaptive hopping techniques. We clarify this because the FNPRM, at paragraph 13, questions, “whether use of adaptive hopping techniques should be mandatory,” without expressly limiting the context to the use of reduced hop sets.

market. We wholeheartedly support the inclusion of new and technically advanced systems such as Orthogonal Frequency Division Multiplexing (“OFDM”).

We note, however, that the Commission has not proposed a definition of “digital transmission system” to complement the definitions of “direct sequence systems” and “frequency hopping systems” under Part 2 of the Commission’s rules.⁴ The Commission has recognized that “Section 2.1 provides for *only two types* of spread spectrum systems: direct sequence and frequency hopping.”⁵ Silicon Wave believes it is essential for the Commission to provide a definition of “digital transmission systems” that covers DTS operational characteristics in light of the characteristics of DSSS and FHSS. To date, the Commission has provided only a negative definition – that DTS is *not* DSSS.⁶ Further, the Commission has only referenced one “flavor” of DTS – OFDM – which the Commission distinguished from DSSS because its use of forward error correction, rather than a high speed data code, is the cause of its bandwidth spreading.⁷ But clearly the Commission anticipates – and hopes – that innovation will produce new, unforeseen forms of digital transmission beyond the scope of OFDM.

The truth is that most systems and devices use some form of digital modulation. Accordingly, unless the Commission clearly defines “DTS” as a separate and distinct third category, it may be possible to “pick and choose” preferable regulatory treatment by denominating one’s device as “DTS,” particularly because the draft rules as now written would allow all DTS to operate at the maximum 1 watt power level.

⁴ 47 C.F.R. § 2.1.

⁵ NPRM at ¶ 23 (emphasis added).

⁶ The Commission has also noted, vaguely, that digital transmissions “have spectrum characteristics *similar* to spread spectrum systems.” Id. at ¶ 15 (emphasis added).

At present, proposed draft rule Section 15.247 (b)(3) may unintentionally override the established categories of DSSS and FHSS. A traditional DHSS or FHSS device that “us[es] digital modulation”⁸ could thus be classified under two categories with different – and perhaps conflicting – rules.⁹ Because most systems use some form of digital modulation, the lack of definitional clarity could, essentially, enact a broad change disadvantaging the low power uses of the band and decreasing the capacity of the band overall.

V. Extension of the U-NII Rules

The Commission also poses interesting questions about the relationship between Section 15.247 and the U-NII band.¹⁰ The Commission essentially asks whether the proposed changes, if adopted, obviate the need for distinct Section 15.247 rules. That is, should the Commission simply amend the U-NII rules to incorporate the 915 MHz and 2.4 GHz bands?¹¹ In addition, should the Commission extend the upper U-NII band to incorporate 5.825-5.850 GHz, directly aligning it with the Section 15.247 5 GHz band (5.725-5.850 GHz).

Silicon Wave supports expansion of the UNII band to realign it with the Section 15.247 spread spectrum 5 GHz band. This would substantially increase flexibility for designers and manufacturers. However, we believe that expanding the U-NII rules to cover 2.4 GHz would be premature and damaging at this point in time. At this stage the Commission has made no specific proposal and provides no consideration of

⁷ Id. at ¶ 25.

⁸ NPRM, Appendix B, proposed rule Section 15.247(b)(3).

⁹ For example, a FHSS device using digital modulation may assert that Section 15.247(b)(1) governs its power usage at all times, even when using reduced hop sets.

¹⁰ See generally, 47 C.F.R. § 15.401 *et seq.*

¹¹ NPRM, at ¶ 18.

disparate use and potential ambiguities and conflicts between the rules. Rule consolidation would not be a technical amendment. A change without full consideration, and planning, would create confusion, hurt legacy users, and stall the products already in the pipeline. Accordingly, Silicon Wave requests that the Commission defer any rule consolidation until a thorough exploration of the consequences may be undertaken.

VI. Elimination of the Processing Gain Requirement

The proposal to eliminate the processing gain requirement – a recognized synonym for the ability to withstand interference¹² – is, by several estimates, mitigated by the increasingly robust performance of new DSSS and digital transmission systems. Silicon Wave believes that the Commission can, as it proposes, safely leave this tradeoff to industry developers.

¹² In its 1990 Report and Order adopting the processing gain requirement for direct sequence spread spectrum devices, the Commission explained the relationship between processing gain and resistance to interference:

“[S]ignal processing in spread spectrum systems tends to suppress undesired signals. This results in significantly higher signal to noise ratios than can be achieved by conventional techniques The improvement in signal to noise ratio is termed ‘processing gain.’”

In the Matter of Amendment of Parts 2 and 15 of the Rules with Regard to the Operation of Spread Spectrum Systems, *Report and Order*, 5 FCC Rcd 4123 (1990), at ¶12.

VI. Conclusion

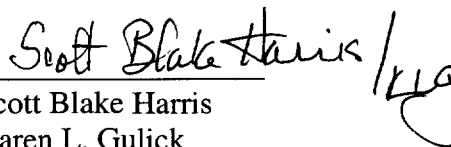
Thus far, the Commission has successfully tread a difficult path with its Part 15 rules. Seeking to ensure that the spectrum is used for the benefit of all, the Commission must reconcile competing challenges: to promote intensive and efficient use of the spectrum, to eliminate barriers to innovation, and to ensure co-existence among many users of diverse technologies. As discussed above, Silicon Wave believes that this rulemaking proceeding provides the opportunity for revisions that will strike the best balance of these priorities in light of current and potential future uses of the band.

Industry innovations already are bumping up against some of the regulatory restrictions at issue here. As borne out by the complex discussions surrounding the digital transmission technologies, we expect resolution of those issues may take longer than the adaptive hopping issues, which have generated widespread support and agreement. With prompt action on the adaptive hopping proposal, the Commission may unleash a new generation of more efficient and dynamic adaptive hopping solutions. Therefore, we urge the Commission to consider (1) bifurcating the issues and promptly issuing an order on adaptive hopping, or (2) issuing waivers for adaptive hopping devices that clearly fall within the bounds of the Commission's proposal pending resolution of the entire docket.

Respectfully submitted,



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